

# Stator for Dynamo-Electric Machine

## Background of the Invention

### 1. Technical Field

The present invention relates to a construction of a  
5 stator for use in dynamo-electric machine including alternator  
for vehicles.

### 2. Background Art

Generally in conventional stators for dynamo-electric  
machine, a plurality of teeth are disposed at the inside  
10 perimeter of a cylindrical magnetic member, and coils are  
disposed inside the slots formed between the teeth. In such  
a construction, coil insertion is a rather complicated work,  
and it is difficult to dispose high-density coils in the slots.

To cope with this problem, a method has been proposed,  
15 for example, in the Japanese Patent Publication (unexamined)  
No. 103052/1997 . To make easy the coil insertion work and the  
disposition of high density coils in slots, this known method  
proposed that a rectangular parallelepiped-shaped laminated  
body is arranged by laminating plate-type magnetic members,  
20 each having a plurality of teeth on one side of a yoke portion,  
and after inserting the coils into slots formed between the  
teeth thereof, the laminated body is annularly bent with the  
coil disposition side inward.

Fig. 33 is a front view of a conventional type stator for  
25 dynamo-electric machine of this type. Figs. 34 (A) and (B) show



electric machine is manufactured.

In the conventional stator for dynamo-electric machine having such a construction as described above, because a laminated body 3 is bent after inserting the coils 4 therein, it is certainly possible to conduct easily the coil insertion work and dispose the coils 4 with high density. However, the yoke portion 2a is required to have a certain thickness to secure a necessary cross sectional area for magnetic path and, therefore, a stronger power is required to bend annularly the laminated body of large thickness. Consequently, a problem exists in that an air gap is formed between both end portions as shown in Fig. 35, and it is difficult to obtain a structurally perfect circle. Moreover, a further problem exists in that the laminated body 3 is distorted to the extent of decreasing magnetic performance, eventually resulting in deterioration of efficiency.

#### Summary of the Invention

The present invention was made to resolve the above-discussed problems and has an object of providing a stator for dynamo-electric machine capable of being easily formed into a perfect circle and preventing deterioration of efficiency.

The invention provides a stator for dynamo-electric machine of which rotor is disposed inside the stator, in which a stator core comprises: an inside ring core formed annularly



ring core. As a result of such construction, it is possible to provide a stator for dynamo-electric machine capable of improving rigidity as well as preventing deterioration of efficiency.

5           The invention provides a stator for dynamo-electric machine, in which thickness of plate-type magnetic members for the outside ring core is smaller than that for the inside ring core. As a result of such construction, it is possible to provide a stator for dynamo-electric machine capable of further preventing deterioration of efficiency.

10           The invention provides a stator for dynamo-electric machine, in which the outside ring core is formed shorter than the inside ring core in axial direction and is fitted in the central part of the inside ring core. As a result of such construction, it is possible to provide a stator for dynamo-electric machine capable of being easily held by a bracket.

15           The invention provides a stator for dynamo-electric machine, in which thickness of the outside ring core in radial direction is larger than that of the yoke portion in the inside ring core. As a result of such construction, it is possible to provide a stator for dynamo-electric machine capable of improving rigidity.

20           The invention provides a stator for dynamo-electric machine, in which thickness of the yoke portion in the inside

ring core in radial direction is larger than that of the outside ring core. As a result of such construction, it is possible to provide a stator for dynamo-electric machine capable of further preventing deterioration of efficiency.

5       The invention provides a stator for dynamo-electric machine, in which concave portions extending in axial direction are respectively provided at positions each substantially corresponding to the central part of the bottom portion of each slot on the outside perimeter of the inside ring core. As a  
10       result of such construction, it is possible to provide a stator for dynamo-electric machine capable of improving working efficiency.

      The invention provides a stator for dynamo-electric machine, in which concave portions extending in axial direction  
15       are respectively provided at positions each substantially corresponding to the central part of the bottom portion of each slot of the inside ring core. As a result of such construction, it is possible to provide a stator for dynamo-electric machine capable of improving working efficiency without decreasing  
20       magnetic performance.

      The invention provides a stator for dynamo-electric machine, in which the outside ring core is formed by integrating a plurality of arc-shaped magnetic members 33a in one piece. As a result of such construction, it is possible to provide a  
25       stator for dynamo-electric machine capable of improving working

efficiency and improving yielding percentage of materials.

The invention provides a stator for dynamo-electric machine, in which concave and convex portions engaging with each other are formed on a face where the inside ring core and the outside ring core are fitted to each other. As a result of such construction, it is possible to provide a stator for dynamo-electric machine capable of improving rigidity.

The invention provides a stator for dynamo-electric machine, in which the concave and convex portions are formed to dovetail with each other. As a result of such construction, it is possible to provide a stator for dynamo-electric machine capable of further improving rigidity.

The invention provides a stator for dynamo-electric machine, in which the face where the inside ring core and the outside ring core are fitted to each other are joined by welding. As a result of such construction, it is possible to provide a stator for dynamo-electric machine capable of improving rigidity.

The invention provides a stator for dynamo-electric machine, in which the outside ring core is divided into parts in axial direction and portions where the parts are fitted are joined together by welding. As a result of such construction, it is possible to provide a stator for dynamo-electric machine capable of improving rigidity.

The invention provides a stator for dynamo-electric

machine, in which the contact portion of the inside ring core is disposed at a position corresponding to each slot. As a result of such construction, it is possible to provide a stator for dynamo-electric machine capable of improving working efficiency.

The invention provides a stator for dynamo-electric machine, in which the contact portion of the inside ring core is disposed at the teeth. As a result of such construction, it is possible to provide a stator for dynamo-electric machine capable of improving working efficiency.

The invention provides a stator for dynamo-electric machine, in which width of the teeth where the contact portion of the inside ring core is disposed is formed larger than the rest. As a result of such construction, it is possible to provide a stator for dynamo-electric machine capable of holding the coils without decreasing rigidity.

The invention provides a stator for dynamo-electric machine, in which the plate-type magnetic members of which thickness is larger than the rest are disposed at two end portions in axial direction. As a result of such construction, it is possible to provide a stator for dynamo-electric machine capable of improving both rigidity and working efficiency.

### Brief Description of the Drawings

Fig. 1 is a front view showing a construction of a stator



for dynamo-electric machine according to Embodiment 1 of the present invention.

Fig. 2 is a front view showing a construction of the stator core in Fig. 1.

5 Fig. 3 is a sectional view taken along the line III-III in Fig. 2.

10 Figs. 4 (A) and (B) show a manufacturing process of the inside ring core in Fig. 2, and Fig. 4 (A) is a front view before inserting coils and Fig. 4 (B) is a front view after inserting the coils.

Fig. 5 is a front view showing another construction of the stator core in Fig. 1, which is different from that in Fig. 2.

15 Fig. 6 is a front view showing a further construction of a stator core in Fig. 1, which is different from that in Fig. 2.

Fig. 7 is an enlarged view showing a construction of the essential parts of the stator core in Fig. 6.

20 Fig. 8 is a front view showing a construction of a stator core of the stator for dynamo-electric machine according to Embodiment 2 of the invention.

Fig. 9 is a sectional view taken along the line IX-IX in Fig. 8.

25 Fig. 10 is a front view showing another construction of a stator core of the stator for dynamo-electric machine, which

is different from that in Fig. 8, according to Embodiment 2 of the invention.

Fig. 11 is a sectional view taken along the line XI-XI in Fig. 10.

5 Fig. 12 is a front view showing a construction of a stator core of the stator for dynamo-electric machine according to Embodiment 3 of the invention.

Fig. 13 is a sectional view taken along the line XIII-XIII in Fig. 12.

10 Fig. 14 is a front view showing a manufacturing process of the stator core of the stator for dynamo-electric machine, which is a different construction from that in Fig. 12, according to Embodiment 3 of the invention.

Figs. 15 (A) and (B) show a manufacturing process of a stator core in Fig. 14. Fig. 15 (A) is a sectional view showing a stator core under production and Fig. 15 (B) is a sectional view showing the stator core after completing the manufacture.

Figs. 16 (A) and (B) show a further manufacturing process of the stator core of the stator for dynamo-electric machine, which is a different construction from that Fig. 12, according to Embodiment 3 of the invention. Fig. 16 (A) is a sectional view showing a stator core under production and (B) is a sectional view showing a stator core after completing the manufacture.

25 Fig. 17 is a front view showing a construction of a stator

core of a stator for dynamo-electric machine according to Embodiment 4 of the invention.

Fig. 18 is a sectional view taken along the line XVIII-XVIII in Fig. 17.

5        Fig. 19 is a front view showing another construction, which is different from that in Fig. 17, of the stator core of the stator for dynamo-electric machine according to Embodiment 4 of the invention.

10       Fig. 20 is a sectional view taken along the line XX-XX in Fig. 19.

Fig. 21 is a front view showing a construction of a stator core of a stator for dynamo-electric machine according to Embodiment 5 of the invention.

15       Fig. 22 is a sectional view taken along the line XXII-XXII in Fig. 21.

Fig. 23 is a partially enlarged view showing a construction of the essential parts of a stator core of a stator for dynamo-electric machine according to Embodiment 6 of the invention.

20       Fig. 24 is a partially enlarged view showing a construction, which is different from that in Fig. 23, of the essential parts of the stator core of the stator for dynamo-electric machine according to Embodiment 6 of the invention.

25       Fig. 25 is a front view showing a construction of a stator

core of a stator for dynamo-electric machine according to Embodiment 7 of the invention.

Fig. 26 is a partially enlarged view showing a construction of the essential parts of the stator core in Fig.25.

Fig. 27 is a front view showing a construction, which is different from that in Fig.25, of the stator core of the stator for dynamo-electric machine according to Embodiment 7 of the invention.

Fig. 28 is a front view showing a construction of a stator core of a stator for dynamo-electric machine according to Embodiment 8 of the invention.

Fig. 29 is a front view showing a construction of a stator core of a stator for dynamo-electric machine according to Embodiment 9 of the invention.

Fig. 30 is a front view showing a construction, which is different from that in Fig. 29, of the stator core of the stator for dynamo-electric machine according to Embodiment 9 of the invention.

Fig. 31 is a front view showing a construction of a stator core of a stator for dynamo-electric machine according to Embodiment 10 of the invention.

Fig. 32 is a sectional view taken along the line XXXII-XXXII in Fig. 31.

Fig. 33 is a front view showing a construction of a stator

for dynamo-electric machine according to the prior art.

Figs. 34 (A) and (B) show a manufacturing process of the stator core of the stator for dynamo-electric machine in Fig. 33. Fig. 34 (A) is a front view showing before inserting the coils and Fig. 34 (B) is a front view after inserting the coils.

Fig. 35 is a view to explain the problem of the stator core in Fig. 34.

#### Description of the Preferred Embodiments

##### 10 Embodiment 1

The present invention is hereinafter described in more detail with reference to the accompanying drawings. Fig. 1 is a front view showing a construction of a stator for dynamo-electric machine according to Embodiment 1 of the invention. Fig. 2 is a front view showing a construction of a stator core in Fig. 1. Fig. 3 is a sectional view taken along the line III-III in Fig. 2. Figs. 4 (A) and (B) show a manufacturing process of the inside ring core in Fig. 2, and Fig. 4 (A) is a front view before inserting coils and Fig. 4 (B) is a front view after inserting the coils. Fig. 5 is a front view showing another construction of the stator core in Fig. 1, which is different from that in Fig. 2. Fig. 6 is a front view showing a further construction of a stator core in Fig. 1, which is different from that in Fig. 2. Fig. 7 is an enlarged view showing a construction of the essential parts of the stator core

in Fig. 6.

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In Figs. 1 through 4, reference numeral 6 is a plate-type magnetic members in which a plurality of teeth 6b are disposed on one side of a yoke portion 6a, and each of slots 6c is disposed between one teeth 6b and another. Two ends of the plate-type magnetic member are formed such that one of the teeth 6b is divided into two parts in direction of width. A required number of such magnetic members are laminated and integrated together to form a rectangular parallelepiped-shaped laminated body 7. Numeral 8 is coils inserted and disposed into respective slots 6c. Numeral 9 is an inside ring core formed by annularly bending the laminated body 7 with coils 8 disposed therein and bringing both end faces into contact with each other. Numeral 10 is a outside ring core, being made of magnetic members and formed cylindrical in shape, which is fitted on outside of the inside ring 9 and forms a stator core together with the inside ring core 9.

A manufacturing process of the stator for dynamo-electric machine of above construction according to Embodiment 1 is hereinafter described.

First, a required number of plate-type magnetic members 6, each of which has a plurality of teeth 6b on one side of a yoke portion 6a, are formed by punching. The plate-type magnetic members 6 are laminated and integrated together by caulking or the like to form the rectangular



it is possible to restrain generation of electromagnetic noises.

In the construction described above, because end faces, i.e., contact portion of the laminated body 7 is disposed at the position corresponding to each of the teeth 6b, any of slots 6c is not negatively affected and the coils 8 are fully held. Therefore, in the process of bending the laminated body 7 and joining the end faces thereof together, the coils 8 does not come apart, thus, an easier work is assured. Furthermore, as shown in Fig. 5, the end faces of the laminated body 7 can be disposed at the position corresponding to each of the slots 6c, whereby the contact area in the joining step becomes small, which allows easy positioning. Further, as shown in Fig. 6 and Fig. 7, the teeth 6b1, where the end faces, i.e., the contact portions of the laminated body 7 are disposed, can be formed to have a larger width W1 as compared with a width W2 of the other teeth 6b2. It is also possible to dispose alternately the teeth 6b1 having the width W1 and the teeth 6b2 of smaller width. In this manner, the teeth, even if they are divided into two, can hold the coils under satisfactory control without decreasing rigidity thereof.

#### Embodiment 2

Fig. 8 is a front view showing a construction of a stator core of the stator for dynamo-electric machine according to Embodiment 2 of the invention. Fig. 9 is a sectional view taken



along the line IX-IX in Fig. 8. Fig. 10 is a front view showing another construction of a stator core of the stator for dynamo-electric machine, which is different from that in Fig. 8, according to Embodiment 2 of the invention. Fig. 11 is a sectional view taken along the line XI-XI in Fig. 10.

In Figs. 8 and 9, the same reference numerals are designated to the same or like parts as those described in the foregoing Embodiment 1, and further description thereof is omitted herein.

Numeral 12 is an outside ring core, which is cylindrical in shape and fitted on the outside of the inside ring core 9 on which coils (not shown) are disposed. The outside ring core 12 is formed by laminating and integrating fixedly a required number of annular plate-type magnetic members 13 in one piece to form a stator core 14 together with the inside ring core 9.

In this Embodiment 2, because the stator core 14 is formed by fitting the outside ring core 12 on the outside of the inside ring core 9, it is possible to prevent deterioration of efficiency and obtain a perfect annular construction easily, in the same manner as in the foregoing Embodiment 1. It is also possible to restrain the occurrence of electromagnetic noises. Furthermore, because the outside ring core 12 is formed into the laminated construction, it is possible to improve magnetic performance and further prevent deterioration of efficiency.

In the construction discussed above, the outside ring core

12 is formed into a laminated construction by laminating a required number of annular plate-type magnetic members 13. It is also preferable to form an outside ring core 16 into a cylindrical laminated construction by winding an elongated plate-type magnetic member 15 spirally, as shown in Figs. 10 and 11, so that the outside ring core 16 is fitted on the outside of the inside ring (not shown in the drawings) to form a stator core. In such a modified construction, it is possible to improve magnetic performance and prevent deterioration efficiency, in the same manner as that in Figs. 8 and 9. Furthermore, in such a modified construction, because the punching step can be omitted, the entire manufacturing process becomes more simple and easy.

### Embodiment 3

Fig. 12 is a front view showing a construction of a stator core of the stator for dynamo-electric machine according to Embodiment 3 of the invention. Fig. 13 is a sectional view taken along the line XIII-XIII in Fig. 12. Fig. 14 is a front view showing a manufacturing process of the stator core of the stator for dynamo-electric machine, which is a different construction from that in Fig. 12, according to Embodiment 3 of the invention. Figs. 15 (A) and (B) show a manufacturing process of a stator core in Fig. 14. Fig. 15 (A) is a sectional view showing a stator core under production and Fig. 15 (B) is a sectional view showing the stator core after completing the manufacture. Figs. 16 (A)





In the drawings, the same reference numerals are designated to the same or like parts as those described in the foregoing Embodiment 2, and further description thereof is omitted herein.

5 As shown in Figs. 17 and 18, reference numeral 18 is a cylindrical outside ring core fitted on the outside of the inside ring core 9 on which coils (not shown) are disposed. The outside ring core 18 is formed by laminating and fixedly integrating in one piece a required number of annular plate-type  
10 magnetic members 19, each having a thickness  $t_2$  larger than a thickness  $t_1$  of each magnetic member 6 forming the inside ring core 9. Thus, a stator coil 20 is formed of the mentioned outside ring core 18 together with the inside ring core 9.

Further, as shown in the Figs. 19 and 20, numeral 21 is  
15 another cylindrical outside ring core fitted on the outside of the inside ring core 9 on which coils (not shown) are disposed. The outside ring core 21 is formed by laminating and fixedly integrating in one piece a required number of annular plate-type magnetic members 19, each having a thickness  $t_2$  smaller than  
20 a thickness  $t_1$  of each magnetic member 6 forming the inside ring core 9. Thus, the mentioned outside ring core 18 forms a stator coil 20 together with the inside ring core 9.

In this Embodiment 4, as shown in Figs. 17 and 18, because  
the outside ring core 18 is formed by laminating the plate-  
25 type magnetic members 19, each having a thickness  $t_2$  larger than

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a thickness  $t_1$  of each plate-type magnetic member 6 forming the inside ring core 9, it is possible to improve rigidity of the stator core 20.

Furthermore, as shown in Figs. 19 and 20, because the outside ring core 21 is formed by laminating the plate-type magnetic members 22, each having a thickness  $t_2$  smaller than a thickness  $t_1$  of each plate-type magnetic member 6 forming the inside ring core 9, it is possible to improve magnetic performance in the stator core 23 and prevent deterioration of efficiency.

#### Embodiment 5

Fig. 21 is a front view showing a construction of a stator core of a stator for dynamo-electric machine according to Embodiment 5 of the invention. Fig. 22 is a sectional view taken along the line XXII-XXII in Fig. 21.

In the drawings, the same reference numerals are designated to the same or like parts as those described in the foregoing Embodiment 2, and further description thereof is omitted herein. Numeral 24 is a cylindrical outside ring core, fitted on the outside of the inside ring core 9 on which coils (not shown) are disposed. The outside ring core 24 is formed by laminating and integrating fixedly in one piece a required number of plate-type magnetic members 25 in such a manner that its length  $l_1$  in axial direction is shorter than the length  $l_2$  in axial direction of the inside ring core 9. The outside ring

core 24 is fitted to the central part of the inside ring core 9. Thus, the mentioned outside ring core 24 forms a stator coil 26 together with the inside ring core 9.

In this Embodiment 5, because the outside ring core 24 is formed so that its length 11 in axial direction is smaller than the length 12 in axial direction of the inside ring core 9 and is fitted to the central part of the inside ring core 9, it is possible to expose the outside perimeter portions of both ends of the inside ring core 9. The exposed portions can be held by a bracket (not shown), which results in easy construction of the dynamo-electric machine.

#### Embodiment 6

Fig. 23 is a partially enlarged view showing a construction of the essential parts of a stator core of a stator for dynamo-electric machine according to Embodiment 6 of the invention. Fig. 24 is a partially enlarged view showing a construction, which is different from that in Fig. 23, of the essential parts of the stator core of the stator for dynamo-electric machine according to Embodiment 6 of the invention.

In the drawings, the same reference numerals are designated to the same or like parts as those described in the foregoing Embodiment 2, and further description thereof is omitted herein.

As shown in Fig. 23, numeral 27 is a cylindrical outside







parallelepiped-shaped laminated body (not shown) becomes easier, and it becomes possible to improve working efficiency.

Furthermore, as shown in Fig 27, because the concave portions are formed extending in axial direction at the central part of the bottom portion of each slot 6c on the inside ring core 9, the process of bending annularly a rectangular parallelepiped-shaped laminated body (not shown) becomes easier and it becomes possible to improve working efficiency in the same manner as in Figs. 25 and 26. Moreover, because the concave portions 32 are formed outside the magnetic path magnetic performance can be improved, and it is possible to prevent deterioration of efficiency.

#### Embodiment 8

Fig. 28 is a front view showing a construction of a stator core of a stator for dynamo-electric machine according to Embodiment 8 of the invention.

In the drawings, the same reference numerals are designated to the same or like parts as those described in the foregoing Embodiment 2, and further description thereof is omitted herein.

Numerals 33 is a cylindrical outside ring core fitted on the outside of the inside ring core 9. The outside ring core 33 is formed by integrating a plurality of arc-shaped magnetic members 33a in one piece.

In this Embodiment 8, because the outside ring core 33 is formed by integrating a plurality of arc-shaped magnetic

members 33a in one piece, such divided magnetic members makes the manufacturing process more simple and easier when any accessory such as cooling fins is integrally formed on the outside perimeter of the outside ring core 33. As a result,  
5 it is possible to improve working efficiency and yielding percentage of materials.

#### Embodiment 9

Fig. 29 is a front view showing a construction of a stator core of a stator for dynamo-electric machine according to  
10 Embodiment 9 of the invention. Fig. 30 is a front view showing a construction, which is different from that in Fig. 29, of the stator core of the stator for dynamo-electric machine according to Embodiment 9 of the invention.

In the drawings, the same reference numerals are designated  
15 to the same or like parts as those described in the foregoing Embodiment 2, and further description thereof is omitted herein.

As shown in Fig. 29, numeral 34 and numeral 35 are concave and convex portions respectively formed to be capable of being  
20 engaged with the inside perimeter of the outside ring core 12 and the outside perimeter of the inside ring core 9. The concave portion 34 and convex portion 35 are disposed at a plurality of positions on the circumference with predetermined intervals.

As shown in Fig. 30, numeral 36 and numeral 37 are  
25 dovetailed concave and convex portions respectively formed to

be capable of being engaged with the inside perimeter of the outside ring core 12 and the outside perimeter of the inside ring core 9. The dovetailed concave portion 36 and convex portion 37 are disposed at a plurality of positions on the circumference with predetermined intervals.

In this Embodiment 9, because the concave portion 34 and convex portion 35 are respectively formed to be capable of being engaged with the inside perimeter of the outside ring core 12 and the outside perimeter of the inside ring core 9, as shown in Fig 29, it becomes possible to prevent displacement of both cores 9 and 12 in circumferential direction and improve rigidity.

Furthermore, as shown in Fig. 30, because the dovetailed convex portion 36 and concave portion 37 are respectively formed to be capable of being engaged with the inside perimeter of the outside ring core 12 and the outside perimeter of the inside ring core 9, it is not only possible to prevent displacement of both cores 9 and 33 in the same manner as in Fig 29, but also possible to prevent formation of air gap between both cores 9 and 33 by restricting a movement in radial direction. As a result, it is possible to improve rigidity and prevent deterioration of magnetic performance.

#### Embodiment 10

Fig. 31 is a front view showing a construction of a stator core of a stator for dynamo-electric machine according to

Embodiment 10 of the invention. Fig. 32 is a sectional view taken along the line XXXII-XXXII in Fig. 31.

In the drawings, the same reference numerals are designated to the same or like parts as those described in the foregoing Embodiment 2, and further description thereof is omitted herein.

As shown in Fig 32, numeral 38 and numeral 39 are plate-type magnetic members, each being laminated and integrated in one piece at both ends of the inside ring core 9 and the outside ring core 12 in axial direction. Thickness of the plate-type magnetic members 38 and 39 is larger than that of other plate-type magnetic members forming the inside ring core 9 and the outside ring core 12.

In this Embodiment 10, because both the plate-type magnetic members 38 and 39, whose thickness is larger than that of other plate-type magnetic members forming the inside ring core 9 and the outside ring core 12, are disposed respectively at two end portions in axial direction to hold both cores 9 and 12 therebetween, it is possible to prevent both the magnetic members 38 and 39 forming the core 9 and 12 from being removed from both end portions. Furthermore, though not illustrated, in the prior art, it has been necessary to apply a rounding work to both end portions of the slot of the inside ring core 9 so as not to damage the inserted coils. However, because thickness of the plate-type magnetic member forming the inside

